US Army Corps of Engineers®
Engineer Research and Development Center

Phosphoric Acid Fuel Cell (PAFC) Demonstration Program

Description of Research

Fuel cells produce electricity, heat, and water through an electrochemical process. Phosphoric acid fuel cell (PAFC) power plants offer several benefits; they are very fuel-efficient, and produce little noise or air pollution. In fiscal years 1993 and 1994, the U.S. Congress funded the use of PAFCs at Department of Defense (DOD) installations. The Construction Engineering Research Laboratory (CERL) was assigned the mission of managing the Fuel Cell Demonstration Program for the DOD. From 1994 to 1997, the PAFC Demonstration Program installed PAFCs at 30 U.S. DOD bases. The program's objectives were to:

- demonstrate fuel cell capabilities in real world situations
- stimulate growth and economies of scale in the fuel cell industry
- determine the role of fuel cells in DOD's long term energy strategy.

Capabilities

- Interfacing the PAFC power plant is a function of compatibility with both the electrical and thermal loads at individual buildings. Potential building types include central heating plants, hospitals, dormitories/barracks, gymnasiums/pools, office buildings, laundries, kitchens.
- Initial electrical efficiencies of PAFC power plants are approximately 36 percent higher heating value (HHV), or 40 percent lower heating value (LHV). If waste heat from the PAFC power plant is used in a cogeneration system, total efficiency can exceed 85 percent.
- PAFC power plant thermal output can be used to preheat boiler make-up water for heating swimming pools, and for DHW used for showers, laundry, and kitchen loads. With an optional high-grade heat exchanger, high-temperature thermal output can be used for boiler plant aerators, space heating loops, absorption chillers, and industrial processes.
- Fuel cells can be configured to provide back-up power. Some PAFC power plants have been used to back-up critical computer loads, acting as a UPS.
- Fuel cells can provide premium power to facilities where "clean" power is required for sensitive electronic equipment.

Fuel cell installation at Fort Huachuca, AZ.

- Fuel cell noise emissions are quite low compared to traditional combustion technologies. At 30 ft, the noise specification level for the PC25C power plant is 62 dBA.
- Packaged PAFC power plants are self-contained units with interface outlets ready to be connected to building loads. Because of low emissions, there is further flexibility to site them in urban areas.

Supporting Technology

CERL developed turnkey PAFC packages; devised site criteria; screened DOD candidate installation sites against selection criteria; evaluated viable applications at each candidate site; coordinated fuel cell site designs; and managed installation and acceptance of the PAFC power plants, and performance monitoring and reporting.

Benefits

The 200 kW PAFC power plants (with an assumed availability of 90 percent or greater) being installed in this demonstration can displace more than 1.5 million kilowatt hours per year of purchased electricity at each site. Use of the thermal energy byproduct (approximately 900,000 BTUs/hr) of the fuel cell may be used to displace combustion-based, less environmentally friendly production of thermal energy. Overall annual energy savings will vary depending on local utility rates. Estimated net energy savings for each of the sites varied from $16,000 to $103,000 per year. These energy savings do not include additional environmental cost benefits of using a non-polluting energy source.

Success Stories

As of November 1997, PAFC power plants have been installed at 30 DOD installations under this program. All of the fuel cells installed in this project are being monitored to determine overall system reliability. Results will be used to determine the role fuel cells should play in DOD long-term energy supply strategy.

ERDC POCs

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